



MEMORANDUM

August 14, 2025

TO: Mauna Kea Stewardship and Oversight Authority

FROM: Greg Chun, Executive Director, CMS

SUBJECT: Informational, Request for Concurrence, VLBA Weather Instruments Upgrade

- Proposal rec'd: 6/12/2025
- Type **A** B / C
- CMS project #359
- ED review: 7/9/2025
- EC review: 7/10/2025
- KKM review: N/A
- MKMB review: 8/5/2025
- MKSOA review: 8/14/2025

I. Project Description

The Very Long Baseline Array facility on Maunakea requests to upgrade its outdoor weather instrumentation:

- Replace the existing instrument bar, weather instruments, and tower junction assembly.
- Replace the interior hardware only of the existing panel box.

The upgrade will replace equipment that is currently obsolete and difficult to maintain and is necessary to maintain correlation between the ten telescopes comprising the Array. No ground disturbance is involved as the work occurs entirely upon existing infrastructure and is expected to have no adverse impacts to any resources. Staff will take about a week to complete the upgrade. Data will continue to be shared with other observatories and the public.

II. Resources Identified

Although the project area is located within the following identified historic properties, project activity is strictly limited to existing infrastructure within the VLBA sublease parcel, in which no identified cultural resources have been identified:

- Mauna Kea Summit Region Historic District, State Inventory of Historic Places (SIHP) Site #50-10-23-26869;
- Mauna A Wākea Traditional Cultural Property and District, SIHP Site 31382; and
- Kūkahau'ula Traditional Cultural Property, SIHP Site 21438.

The facility is regularly monitored for arthropods. In addition, No Rare, Threatened, or Endangered species have been documented inhabiting the site. Recreational visitors may use the VLBA driveway for sightseeing and do not otherwise have facility access. The facility may observe astronomical resources at any time of day.



III. Impacts Identified

As the work is limited to existing infrastructure, will not extend or enlarge VLBA's footprint, and does not change the permitted use of the facility, the applicant does not anticipate any impacts to any identified historic properties or cultural resources, nor to any natural (geological and hydrological), biological, recreational, or scientific resources.

IV. Recommended Mitigation

CMS identifies the land use as HAR §13-5-22, P-8, Structures and Land Uses, Existing (A-1) *Minor repair, maintenance, and operation to an existing structure, facility, use, land, and equipment*. A request for concurrence will be sought from the Office of Conservation and Coastal Lands (OCCL), following presentations to the Environment Committee, Maunakea Management Board, and the Mauna Kea Stewardship and Oversight Authority. The project will not proceed unless all applicable reviews are completed and approvals obtained. Standard Best Management Conditions and applicable approval conditions will be complied with.

V. Compliance with Maunakea Comprehensive Management Plan

The request is consistent with the 2022 Comprehensive Management Plan (CMP), approved by the Board of Land and Natural Resources. In fulfillment of the CMP's community review requirements, the project was presented to the Environment Committee on July 10, 2025 and to the Maunakea Management Board on August 5, 2025, to no concerns or objections. The proposed land is also consistent with UH's General Lease for the Science Reserve (S-4191) and VLBA's sublease. Further, CMS' review of the project complies with the following CMP Actions:

- NR-1: Limit threats to natural resources through management of permitted activities and uses. Habitat alteration and disturbance will be minimized via implementation of Construction Guidelines detailed in the CMP's six Permitting and Enforcement Actions, including:
 - P-1: Comply with all applicable federal, state, and local laws, regulations, and permit conditions related to activities in the UH management Areas.
 - P-2: Strengthen CMP implementation by recommending that compliance with the CMP be a condition of permits and agreements.
 - P-4: Educate management staff and users of the mountain about all applicable rules and permit requirements
- IM-5: Develop and implement a Debris Removal, Monitoring and Prevention Plan, particularly that "All incidental rubbish and debris shall be secured in a windproof rubbish bin or kept indoors."
- C-9: Inspection of construction materials. Shipping containers and crates will be inspected by a DLNR-approved biologist or by Department of Agriculture personnel prior to arriving at Maunakea. Identified mitigation measures will be complied with.



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- EO-2: Require orientation of users. All project workers will be required to successfully complete the Maunakea Resource Orientation prior to working onsite.
- AR-2: Prevent light pollution, radio frequency interference (RF) and dust. Contractors and staff will be informed to keep within posted speed limits to minimize dust.

VI. Center for Maunakea Stewardship Recommendation

CMS recommends the project proceed to OCCL for concurrence review and approval with the standard project conditions in the attached list, should the project be approved.

Facility Project Proposal for the UH-Managed Lands

for projects anticipated to be classified as having “Minimal Impact”

Please mark all that apply to your project

- ☒ Project was reviewed in a 3-Year Plan
- ☐ Project is a CMP, lease, or sublease compliance measure (e.g., keeps the site in safe working order)
- ☐ Project involves heavy machinery
- ☐ Project requires ground disturbance such as digging or trenching
- ☐ Project will result in a change to the facility footprint
- ☐ Project affects a viewplane (e.g., starline or oceanic gridline)

Facility Name

National Radio Astronomy Observatory, Very Long Baseline Array (VLBA) - Mauna Kea

Brief Descriptive Title of Project

Mauna Kea VLBA Weather Station Replacement

Introduction

The VLBA is a collection of ten antennas and associated instrumentation spanning the continental US, Hawaii, and Caribbean. The ten antennas are used as an interferometer where the recorded radio waves are brought to a common location (Socorro, New Mexico) where they are cross-correlated. These output data are calibrated and then processed to form images, spectra, and astrometric data products used by the astronomical and geophysical communities. Accurate on-site weather assessment plays three major roles in this endeavor:

1. Conditions at VLBA-MK and the other nine VLBA sites are used in the dynamic scheduling process to determine which projects are most suitable. High-frequency observing (generally above 20 GHz) requires lower wind and humidity than low-frequency observing. Serious weather conditions identified either based on site weather, satellite data, or forecasts may suggest that the antenna not be used for observing or even be placed into a safe configuration.
2. To accurately point the antennas at higher frequencies, it is critical to correct for atmospheric refraction. Surface temperature, pressure, and humidity measurements made on site are fed into refraction models to correct for the bending of light (and radio waves!) through the atmosphere.
3. After observing, the signals need their electrical pathlengths (from radio source to receiver) to be matched to within a fraction of a wavelength (centimeters or millimeters). Weather models, such as the Vienna Mapping Functions, utilize surface weather data to augment numerical weather modeling and achieve the most accurate results.

Project Description

The technicians for the NRAO Very Large Array site in Hawaii will perform the replacement.

- Removal of the old instrument bar, weather instruments, and tower junction assembly.
- Removal of the interior of the existing panel box.
- Installation of the new instrument bar, weather instruments, and tower junction assembly.
- Installation of new interior hardware in the existing panel box.

For more details on the Scope of Work and materials used, please see document 003.55.20.20.35-0001-SOP-WeatherStationInstallation, which describes work to be done and components that will be replaced during the installation process.

Proposed Commencement Date

Late September 2025, or earlier if the approval process allows.

Proposed Completion Date

Within about 1 week of project commencement.

Estimated Project Cost

\$50,000 USD

Total size / area of proposed use

The area is the same as the current weather station.



Figure 1: The VLBA site at Mauna Kea (photo courtesy Tony Sylvester). The weather station is seen at the far-left corner of the lot as seen here.

Project Purpose and Need

The weather station at the Mauna Kea VLBA site has not undergone an overhaul since its construction in the early 1990s. Sensors have been replaced, but acquiring sensors that are compatible with the system is becoming increasingly difficult. The instrumentation is obsolete. The wiring is becoming challenging to maintain and interface with modern computers. For these reasons, the weather station has been redesigned and is being deployed at all ten VLBA sites. The new sensor package will be visually very similar to the existing package, and the existing tower will be reused. Overall, this is a like-for-like replacement with the goal of improving maintainability and reliability. This replacement has been anticipated and documented starting with the 2023-2025 the CMS Three-Year-Outlook.

The design utilizes Vaisala instrumentation interfaced to the Monitor and Control and Operations systems to provide environmental data that affects the safety of the antenna and observing, including wind speed and gust, temperature, precipitation, dew point, and barometric pressure.

There will be minimal changes to the structures; the most significant change is the look of the weather monitoring instruments (see images below).

Has professional peer-review occurred

Internal NRAO engineering reviews were performed. This will be the 10th and final installation of identical equipment at VLBA sites, with some minor design improvements made after the first two installations.

Are there any related ongoing, pending, or planned projects associated with this submission?

No. It is possible (but unlikely) that this project will occur at the same time as the already-approved “Mauna Kea Sub-reflector Painting” project.

Description of the Project

Location

The footprint will be identical to the existing weather station, tower, and tipping bucket.

The only change to the configuration will be the tower instruments as seen in the pictures below.



Figure 2; VLBA Pie Town Weather Station Old (R) and Replacement (L)

Description of the process of completing the project

For a complete description of the process, please see the associated document 003.55.20.20.35-0001-SOP-WeatherStationInstallation.

Who will do the work?

The work will be done by our local VLBA technicians and an additional technician from one of our sister sites who has experience with the replacement process.

Equipment & Transportation

The replacement components for the Weather Station have already been shipped, and no additional equipment or transportation beyond the usual maintenance requirements for the antenna will be needed.

Measures to protect the environment and/or mitigate impacts

Impacts

The environmental impacts will be minimal.

This is standard equipment maintenance; it should not violate the Lease, Sublease, or Comprehensive Management Plan (CMP).

All parts that cannot be recycled on the island will be shipped back to the Domenici Science Operations Center in Socorro, New Mexico.

Options include:

Kaʻauhuhu Recycling and Transfer Station
55-3558 Kaaauhuhu Rd, Hawi, HI 96719, Usa, Hāwī, HI 96719
(808) 961-8270
hawaiiizerowaste.org

Mr. K's Recycle and Redemption Center.
815 Kinoole St, Hilo, HI 96720
[\(808\) 969-1222](tel:8089691222)
www.mrksrecyclehawaii.com

Compliance with Lease, Sublease, or Comprehensive Management Plan (CMP)

Skip this step if the project is a CMP, lease, or sublease compliance action. Otherwise, submit a draft of the CMP matrix as a separate Excel file.

Identify other required or associated permits.

None.

Community Benefits

Benefits to other Maunakea entities and/or global astronomy community

The weather data produced by the VLBA weather station is made available to the MK Weather Center and to individual MK Observatories, where the data are used as inputs to weather models and to inform decision-making on road use during winter. The VLBA is located at an elevation on Mauna Kea that is not otherwise served by weather infrastructure.

Benefits to the Hawaii Island community

No direct benefits.

Will data, publications, or other products be free and available to the public?

Weather data from the VLBA weather station are included in all archival VLBA data produced. Its impact on publications is through the enhanced calibration and hence improved images that it facilitates.

For internal use only by CMS

Review checklist

- ☐ Staff review and report
- ☐ Outside agency review or approval required
- ☐ Environment committee, if environmental impacts are anticipated
- ☐ Kahu Ku Mauna, if cultural impacts are anticipated and KKM requested consultation, or the project was not included in a 5YP or 3YP
- ☐ Maunakea Management Board

Project approval conditions

Prepare to Start the Project

- Identify and comply with other permit requirements, such as County of Hawai'i building permits or Department of Land & Natural Resources permits (see *both*/any applicable DLNR permit and [HAR §13-5-42 Standard conditions](#)).
- Use of real-time GPS during any surveying or equipment operation requires advance written approval from CMS and the Institute for Astronomy. GPS use should be requested at least four (4) weeks prior to the proposed activity.
- Any required Best Management Practices, Communication Plans, contract scope questions, etc. must be finalized and approved by CMS prior to final approval.
- CMS will provide a final, written notice explicitly stating whether the project is approved to commence (i.e., issue a "Notice to Proceed"). The Notice to Proceed will include any additional, project-specific conditions. **No project work may commence before this time.**
- Project approval may not be transferred or assigned without prior authorization. A copy of the approval/permit must be present on-site and available for review at all times while working on UH-managed lands.
- Applicant shall comply with all actions and measures described in the proposal, including (community) benefits, CMP compliance list, and mitigation measures.

Notifications

- Applicant may request to arrange a pre-construction meeting with CMS before work commences. These meetings review orientation content, implications of project non-compliance, project-specific concerns regarding resource protection, health and safety, visitor and/or traffic impacts, etc. Meetings may be held in person or via phone, webinar, or other means.
- Notify CMS in writing via email to cmshilo@hawaii.edu at least five (5) days prior to beginning field work on UH-managed lands (Halepōhaku, Road Corridor, Maunakea Science Reserve, or Astronomy Precinct) with the following:
 - Identify the date that onsite work will commence.
 - Identify by name-of-entity all observatories, contractors, vendors, suppliers, etc. anticipated to be associated with and substantively present on UH-managed lands for the project.
 - Identify the individual(s) who will be coordinating all invasive species inspections.
 - Attest that the observatory or relevant entity will ensure compliance with all permit conditions and communicate with CMS if there is any uncertainty.
 - Notify CMS in writing of any other entities responsible for elements of compliance.
 - Attest that all individuals anticipated to be associated with the project have completed the Maunakea User Orientation.
 - CMS is not liable or responsible for delays due to inadequate or late submissions or submissions requiring verification.

Onsite Activity

General

- Use of lighting from sunset to sunrise is prohibited unless described in the project proposal and approved.
- Use of cell-phones, other than in airplane mode, is prohibited except in case of emergency.
- Placement of permanent markers, monuments, mag nails, or survey pins, etc. is not allowed without explicit prior approval from CMS (and the State if required). ALL surveyors' work must be shared with CMS in digital format with coordinate info stored in and using a common, transferrable coordinate reference system such as "State Plane Coordinates (NAD83), Hawai'i Zone 1".
- Allow CMS Rangers to visit and monitor activities.

Transportation and Motorized Equipment

- No use of mechanized equipment is allowed unless authorized by this permit.
- 4-wheel-drive required for travel above Halepōhaku.
- Large, heavy, non-4-wheel-drive or oversized loads must submit notification to the Maunakea Road Conditions listserv, MK-ROAD-CONDITIONS@lists.hawaii.edu, at least one day prior to transit. Loads requiring an escort on public roadways must have this escort accompany them to the final destination. Projects failing to submit notification or arrange for escort to the summit may be denied entry to Halepōhaku or above.
- During public closures of the Summit Access Road, vehicle access above Halepōhaku is limited to explicitly-marked observatory, CMS, federal, or state of Hawaii vehicles. Vehicles must be operated by approved employees or representatives on official business and possessing requisite orientation, training, safety, and rescue supplies.
- Motorized equipment, when stationary, must have a drain-pan in place suitable for catching fuel or fluid leaks.

Debris Prevention and Severe Weather Concerns

- Ensure that any debris, tools and equipment are secured to avoid becoming windblown and are properly stored at the end of each day.
- Projects occurring in the summit region must verify that temporary and permanent infrastructure and improvements can sustain 120 MPH winds and severe weather.

Environmental Concerns

- All perishable items including food, food wrappers, and containers must be removed from the site daily and properly disposed of.
- Remove and properly dispose of all waste material.
- Nēnē (*Branta sandvicensis*) may be present. If a nēnē appears within 100 feet (30.5 meters) of ongoing work, all activity shall be temporarily suspended until the animal leaves the area of its own accord. Federal law prohibits feeding or any "taking" (e.g., harassing, harming, killing) of nēnē.
- Best Management Practices for seabirds, including the endangered Hawaiian petrel (*Pterodroma sandwichensis*)
 - Use red light bulbs outside to the maximum practicable extent.
 - Fully shield outdoor bulbs so the light is only visible from below.
 - Install motion sensors or turn off lights when human activity is not occurring in the area.

- September-December: Avoid nighttime construction.
- Best Management Practices for the endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*)
 - No barbed-wire fencing allowed.
 - June-November: Do not trim, remove, or disturb trees over 15 feet tall.

Invasive Species Prevention

- Employ invasive species prevention best practices, including inspections of materials by a DLNR-approved biologist, as identified in the Maunakea Invasive Species Management Plan prior to entering UH-managed lands.
 - Inspections can only occur at locations where landowners have given permission (i.e. facilities, baseyards, and vendor locations).
 - Inspections shall not occur on UH-managed lands on Maunakea, at State or County parks, along public roadsides, or on Department of Hawaiian Homelands lands.

Upon Project Completion

- The project must be completed within the time frame specified in the proposal and, when applicable, as specified by DLNR. Projects that cannot be completed within this timeframe are not allowed to continue (or commence) without explicit prior written approval from CMS.
- Notify CMS in writing when field activity associated with the project is completed.
- Unless otherwise stated in the proposal, copies of all data, field notes, photos, log books, collected specimens, and other forms of documentation will be shared with CMS for future, unrestricted use by CMS or its designee. All geospatial data, metadata or applications must be in a format compatible with CMS GIS software or other industry standard identified in advance.
- Collected specimens that are not consumed in analysis will be returned to CMS unless otherwise specified.
- Provide CMS with electronic and paper copies of all publications resulting from the work. When applicable, annual, final reports must be submitted to CMS.
- When applicable, a brief, approximately 1-page, non-technical summary suitable for public outreach (school groups, community meetings, newsletter articles, etc.) must be provided to CMS within 90 days of project completion or publication. Photos and illustrations are encouraged.